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| EXAMINER |
|---|
| SONG, MATTHEW J |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1765 | |

DATE MAILED: 06/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/904,131 | Applicant(s) UEDA, TETSUZO |
|---|---|---|
| | Examiner Matthew J Song | Art Unit 1765 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *02 April 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *11-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *11-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 29-30 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 29 recites, "without rotating the substrate" in line 3. The instant specification does not teach growing an epitaxial layer without rotating the substrate, but is merely silent to any rotation or lack thereof. The mere absence of a positive recitation is not basis for an exclusion, note MPEP 2173.05(i). Likewise for claim 30.

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 11, 13, 14, 24-26 and 28 are rejected under 35 U.S.C. 102(e) as being anticipated by Molnar (US 6,086,673).

Molnar discloses growing an III-V nitride epitaxial layer on a foreign substrate, where the foreign substrate which can be employed includes sapphire, spinel, silicon carbide, silicon, YAG, GGG, gallium arsenide, titanium nitride, titanium carbide, ScN, InN, AlN, $In_xGa_yAl_{1-x-y}As$, $In_xGa_yAl_{1-x-y}$ or $In_xGa_yAl_{1-x-y}N$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$,and $0 \leq x+y \leq 1$. Molnar also discloses the growth substrate can also consist of layered structures composed of combinations of these materials and other such materials (col 7, ln 1-20 and Abstract). Molnar also disclose the substrate can be removed from a GaN epitaxial layer by etching, electrochemical polishing or by other suitable processes (col 11, ln 25-40). Molnar also discloses a growth temperature of 800-1250°C for GaN deposition (col 9, ln 20-30) and cooling the substrate after deposition at a rate of 1°C/min to 200°C/min under a $NH_3$ atmosphere (col 11, ln 15-30)

Molnar is silent to the thermal coefficients of the substrate materials, however this is inherent to Molnar because the different materials of a layered substrate, such as sapphire and GaN ($In_xGa_yAl_{1-x-y}N$, where x=0 and y=1), inherently have different thermal coefficients. Also, applicant's admission teaches a thermal mismatch between GaN and sapphire (pg 3, ln 1-15).

Molnar is also silent to the layered substrate exhibits bowing. However, this is inherent to Molnar because Molnar discloses a layered substrate of SiC and sapphire, as applicant, note instant claim 13. Also, Applicant's admission teaches a layered substrate, where the bowing of a GaN/ sapphire substrate occurs for a GaN thickness of greater than 0 microns (Fig 1C).

Referring to claim 13-14, Molnar teaches an III-V nitride epitaxial layer and a substrate of a layered structure of Sapphire and silicon, sapphire and an III-V nitride, sapphire and ZnO, and sapphire and SiC.

Referring to claim 24, Molnar discloses removing the substrate (col 11, ln 25-40).

Referring to claim 25, Molnar discloses electrochemical polishing, this reads on applicant's mechanical polishing.

Referring to claim 26, Molnar discloses a layered substrate of GaN and sapphire. Molnar also discloses forming a GaN layer on a sapphire substrate at a temperature between 800 and 1250°C and cooling at a rate of 1-200°C/min, Molnar is silent to the layered substrate exhibits bowing after being cooled down, however this is inherent to Molnar because Molnar discloses similar layers, as applicant, which have different coefficients of thermal expansion and Molnar discloses cooling the substrate, as applicant.

Referring to claim 28, Molnar discloses forming an epitaxial layer on a substrate, which inherently exhibits bowing, as applicant. Molnar is silent to growing an epitaxial layer on a layered substrate which exhibits bowing is conducted so as to flatten the bowed layered substrate. This is inherent to Molnar because Molnar discloses forming a similar epitaxial layer on a similar substrate, as applicant.

5. Claims 11 and 13-14 are rejected under 35 U.S.C. 102(b) as being anticipated by Manabe et al (US 5,620,557).

Manabe et al discloses a sapphire substrate **1**, intermediate ZnO layers **2a, 2b**, on the sapphire substrate and forming GaN layers **3a, 3b** by Metal organic vapor phase epitaxy on the

intermediate ZnO layers, where the sapphire substrate and intermediate ZnO layer reads on applicant's layered substrate (col 2, ln 55 to col 3, ln 19). Manabe et al also discloses the sapphire substrate with the intermediate ZnO layers and the GaN semiconductor layers was dipped into an etching liquid of hydrochloric acid and the intermediate ZnO layers were etched off, thereby the GaN semiconductor layers were separated from the sapphire substrate (col 3, ln 20-35). Manabe et al is silent to the two layers of the layered substrate have different thermal coefficients, but this is inherent to Manabe because the two different materials of the substrate inherently have different thermal coefficients. Manabe et al also discloses GaN layers are formed by releasing reactant gases over bother surfaces of the sapphire substrate (col 3, ln 15-24). Manabe et al also teaches other III-V nitrides, $Al_xGa_yIn_{1-x-y}N$, can be formed (claim 1).

Manabe et al is silent to a layered substrate exhibits bowing. However, Manabe et al discloses a similar layered substrate of ZnO and sapphire, as applicant, and a high temperature of 1000°C for the deposition of GaN (col 3, ln 5-10), therefore because of the inherent difference in thermal coefficients of sapphire and ZnO the substrate will inherently exhibit bowing at a temperature of 1000°C.

Referring to claim 14, Manabe et al teaches gallium nitride **3a** on zinc oxide **2a** on sapphire **1** on zinc oxide **2b** (Fig 3).

### *Claim Rejections - 35 USC § 103*

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Molnar (US 6,086,673) as applied to claims 11, 13, 14, 24-26 and 28 above, and further in view of Zheleva et al (WO 99/65068).

Molnar discloses all of the limitations of claim 12 including the deposition of an epitaxial gallium nitride layer, as discussed previously, except the step of selective etching a portion of the epitaxial layer.

In a method of forming improved gallium nitride layers, note entire reference, Zheleva et al teaches an underlying gallium nitride layer **104** is grown on a SiC substrate **102** and the underlying gallium nitride layer includes a plurality of sidewalls **105** (pg 5, ln 10-35). Zheleva et al also teaches the posts **106** and trenches **107** that define the sidewalls **105** may be fabricated by selective etching (pg 6, ln 1-5). Zheleva et al also teaches the sidewalls **05** of the gallium nitride layer are laterally grown to from a lateral gallium nitride layer **108a** in the trench **107**. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Molnar with Zheleva et al's selective etching of GaN to form a trench which can be used to form a relatively defect free GaN semiconductor layer (pg 2, ln 15-20).

8. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Molnar (US 6,086,673) as applied to claims 11, 13, 14, 24-26 and 28 above, and further in view of Kito et al (US 6,110,279).

Molnar discloses all of the limitations of claim 25, as discussed previously. However, if there is an art recognized difference between electrochemical polishing and mechanical polish and electrochemical polishing does not read on mechanical polishing; then it would be obvious in view of Kito et al.

In a method of producing a single crystal, note entire reference, Kito et al teaches forming a SiC single crystal layer **15** on a Silicon wafer **14** and removing the silicon wafer by a chemical technique whereby only the SiC layer remains. Kito et al also teaches a mechanical polishing step may be employed instead of the chemical technique (col 45-60). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Molnar with Kito et al's method of removing a substrate using mechanical polishing because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

9. Claims 15-16, 18-21, 27 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hansson (DE 198 47 101), where US 6,316,361 is used an accurate translation, but a translation of DE 198 47 101 can be provided upon request, or Hansson (US 6,316,361) in view of Westmoreland (US 5,227,331).

Hansson discloses placing a semiconductor wafer in a CVD reactor **1** having an upper reaction chamber **2**, a lower reactor chamber **3** and a dividing wall **4** and a holding ring **6**, heating the semiconductor wafer and depositing a layer on the back of the wafer and simultaneously depositing an epitaxial layer on the front and the back of the wafer by feeding various process gases into the two reactor chambers (col 3, ln 1-67, col 4,ln 30-65 and Fig 2 of '361). Hansson discloses an advantage is that epitaxial layers can be deposited simultaneously on

both sides of a wafer using only one CVD reactor (col 2, ln 25-65 of '361). Hansson also discloses a polysilicon layer can be deposited on the back of the wafer (col 3, ln 11-16 of '361). Hansson also discloses while at least one epitaxial layer is being deposited on the front of the wafer in the upper reactor, the lower reactor is flushed with inert flushing gas (col 3, ln 25-33 of '361). Hansson also discloses a feed lines **11** and **13** and forming a protective layer on the backside of the wafer and forming an epitaxial layer on the front side (Claim 1). Hansson also discloses heat sources **15** located on the exterior of the chamber (Fig 2). Hansson discloses the process gases for an epitaxial layer are well known and trichlorsilane is preferable (col 3, ln 20-35). Hansson also discloses the protective layer of $Si_xN_yH_z$, the process gases for an epitaxial layer using trichlorosilane and $Si_xN_yH_z$ are inherently different. The process gases used for $Si_xN_yH_z$ reads on applicants another set of reactant species.

Hansson does not disclose directly heating the substrate by a radiation source with using any heat sink material.

In an improved CVD method for semiconductor manufacturing, note entire reference, Westmoreland teaches a heat source uses radiant energy to heat a semiconductor structure, where tungsten halogen lamps and graphite heaters are suitable (col 2, ln 50-60). Westmoreland also teaches the heat source can be located within the reaction chamber of the CVD reactor, this reads on applicant's directly heating by a reaction source without using any heat sink material because the radiation means is located inside the chamber rather than outside the chamber and the heat source is shown to act directly on a substrate (Fig 1B). Westmoreland also teaches the heat source is preferably directed at the semiconductor structure for instantaneously increasing the surface temperature thereof (col 5, ln 1-55). It would have been obvious to a person of ordinary

skill in the art at the time of the invention to modify Hansson with Westmoreland's heat source located within the reaction chamber to improve the deposition of reactant gases over a narrow temperature range ('331 col 4, ln 64-68).

Referring to claim 19, the combination of Hansson and Westmoreland teaches a holding ring **6**, this reads on applicant's placing a substrate in a system so that each side of the substrate is not completely covered by any parts or susceptor blocks, and a dividing wall, this reads on applicant's preventing mixing of the two sets of reactant gases and a heating means located within the chamber, this reads on applicant's without using any heat sink materials.

Referring to claims 20 and 27, the combination of Hansson and Westmoreland teaches a dividing wall **4**, this reads on applicant's physical partition.

Referring to claim 21, the combination of Hansson and Westmoreland teaches inert flushing gases, this reads on applicant's inert gas flows.

Referring to claim 29-30, the combination of Hansson and Westmoreland teaches the holding ring **6** can be rotated using a device **10**, rotation is not required by the combination of Hansson and Westmoreland. Also, the combination of Hansson and Westmoreland teach a simultaneous deposition, this reads on without cooling down to room temperature, and heating to 600-1200°C during deposition ('361 col 3, ln 65 to col 4, ln 5).

10. Claims 17 and 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hansson (DE 198 47 101), where US 6,316,361 is used an accurate translation, but a translation of DE 198 47 101 can be provided upon request, in view of Westmoreland (US 5,227,331) as applied to claims 15-16, 18-21, 27 and 29-30 above, and further in view of Manabe et al (US 5,620,557).

The combination of Hansson and Westmoreland teach all of the limitations of claim 22, as discussed previously, except both sets of reactant species comprise a nitrogen source and a group III metal source.

In a method of making a semiconductor, Manabe et al discloses a sapphire substrate **1**, intermediate ZnO layers **2a, 2b**, on the sapphire substrate and forming GaN layers **3a, 3b** by Metal organic vapor phase epitaxy on the intermediate ZnO layers (col 2, ln 55 to col 3, ln 19). Manabe et al also discloses GaN layers are formed by releasing reactant gases of ammonia, a nitrogen source, and trimethyl gallium, a group III metal source, over both surfaces of the sapphire substrate (col 3, ln 15-24). Manabe et al also teaches other III-V nitrides, $Al_xGa_yIn_{1-x-y}N$, can be formed (claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Hansson and Westmoreland with Manabe et al to form gallium nitride, which is a useful compound semiconductor for light emitting diodes (col 1, ln 10-26).

Referring to claim 23, the combination of Hansson, Westmoreland and Manabe et al teaches supplying nitrogen and a group III metal and forming a polysilicon protective layer on the back side using trichlorosilane (col 3, ln 25-30).

### *Response to Arguments*

11. Applicant's arguments with respect to claims 11-30 have been considered but are moot in view of the new ground(s) of rejection.

### *Conclusion*

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Solomon (US 5,919,305) teaches substrate removal using etching or polishing away after an epitaxial layer is formed and the motivation is to reduce optical absorption or reduce resistive heating in the epitaxial layer by providing a better heat sink directly to the epitaxial layer (col 1 and col 2).

Lee et al (US 4,835,116) teaches III-V/Si and III-V/(Ge/Si) wafers exhibit warping due to thermal strain (col 4, ln 20-30).

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
June 4, 2003

BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
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